

ened the original curved row of spots to a straight bar, is most strikingly shown by the two foremost spots of the row which are unsymmetrical with regard to the corresponding row on the front wings, and which really form the commencement of a curved bar, but these are hidden by the overlapping of the front wings.

Thus it was perhaps the selection of males by the females that first perfected the *Medea* type among the progenitors of the genus. Later on the males of some of the species may have been completely modified (as with *E. acontius*), while the females retained their peculiar pattern (by reciprocal selection or by sexually limited inheritance?) down to the present time.

In conclusion, attention is directed to the scent-secreting organ of *Epicalia acontius* as compared with that of another butterfly belonging to a quite different group, viz., *Antirrhæa archæa*, the organ being almost identical in these two widely-separated species, and thus affording a striking instance of what is well known to evolutionists as "analogy," in contradistinction to "homology."

R. MELDOLA

SUN-SPOTS AND COMMERCIAL CRISES

I HAVE been repeatedly told by men who have good opportunity of hearing current opinions, that they who theorise about the relations of sun-spots, rainfall, famines, and commercial crises are supposed to be jesting, or at the best romancing. I am, of course, responsible only for a small part of what has been put forth on this subject, but so far as I am concerned in the matter, I beg leave to affirm that I never was more in earnest, and that after some further careful inquiry, I am perfectly convinced that these decennial crises do depend upon meteorological variations of like period, which again depend, in all probability, upon cosmical variations of which we have evidence in the frequency of sun-spots, auroras, and magnetic perturbations. I believe that I have, in fact, found the missing link required to complete the first outline of the evidence.

About ten years ago it was carefully explained by Mr. J. C. Ollerenshaw, in a communication to the Manchester Statistical Society (*Transactions*, 1869-70, p. 109), that the secret of good trade in Lancashire is the low price of rice and other grain in India.¹ Here again some may jest at the folly of those who theorise about such incongruous things as the cotton-mills of Manchester and the paddy-fields of Hindostan. But to those who look a little below the surface the connection is obvious. Cheapness of food leaves the poor Hindoo ryot a small margin of earnings, which he can spend on new clothes; and a small margin multiplied by the vast population of British India, not to mention China, produces a marked change in the demand for Lancashire goods. Now, it has been lately argued by Dr. Hunter, the Government statist of India, that the famines of India do recur at intervals of about ten or eleven years. The idea of the periodicity of Indian famines is far from being a new one; it is discussed in various previous publications, as, for instance, "The Companion to the British Almanack for 1857," p. 76. The principal scarcities in the North-Western and Upper Provinces of Bengal are there assigned to the years 1782-3, 1792-3, 1802-3, 1812-13, 1819-20, 1826, 1832-3. Here we notice precise periodicity up to 1812-13, which, after being broken for a time, seems to recur in 1832-3.

Partly through the kind assistance of Mr. Garnett, the Superintendent of the British Museum Reading Room, I have now succeeded in finding the data so much wanted to confirm these views—namely, a long series of prices of grain in Bengal (Delhi). These data are found in a publication so accessible as the *Journal* of the London Statistical Society for 1843, vol. 6, pp. 246-8, where is printed a very brief but important paper by the Rev.

¹ This view is confirmed by the opinion of Mr. E. Helm, as given in the *Transactions* of the same society for 1868-9, p. 76.

Robert Everest, chaplain to the East India Company, "On the Famines that have devastated India, and on the Probability of their being Periodical."

Efforts have, I believe, been made by Dr. Hunter, Mr. J. H. Twigg, and probably others, to obtain facts of this kind, which would confirm or controvert prevailing theories; but this little paper, which seems to contain almost the only available table of prices, has hitherto escaped the notice of all inquirers, except, indeed, Mr. Cornelius Walford. The last number of the *Journal* of the London Statistical Society contains the second portion of Mr. Walford's marvellously complete account of "The Famines of the World, Past and Present," a kind of digest of the facts and literature of the subject. At pp. 260-1 we find Everest's paper duly noticed. In this latter paper we have a list of prices of wheat at Delhi for seventy-three years, ending with 1835, stated in terms of the numbers of seers of wheat—a seer is equal to about 21lb. avoirdupois—to be purchased with one rupee. As this mode of quotation is confusing, I have calculated the prices in rupees per 1,000 seers of wheat, and have thus obtained the following remarkable table:—

Price of Wheat at Delhi

1763	50 M.C.	1800	22
1764	35	1801	23
1765	27	1802	25
1766	24	1803	65 M.
1767	23	1804	48 C.
1768	21	1805	33
1769	24	1806	31
1770	28	1807	28
1771	33	1808	36
1772	38 C.	1809	40
1773	100 M.C.	1810	25 C.
1774	53	1811	28
1775	40	1812	44
1776	25	1813	43
1777	17	1814	30
1778	25	1815	23 C
1779	33	1816	28
1780	45	1817	41
1781	55	1818	39
1782	91	1819	42
1783	167 M.C.	1820	46
1784	40	1821	38
1785	25	1822	35
1786	23	1823	33
1787	22	1824	39
1788	23	1825	39 C.
1789	24	1826	48 M.C
1790	26	1827	30
1791	33	1828	22
1792	81 M.	1829	21
1793	54 C.	1830	21
1794	32	1831	26
1795	14	1832	22
1796	14	1833	33
1797	15	1834	40 M.
1798	8	1835	25
1799	17	1836	— C.

The letter M indicates the maxima attained by the price, and we see that up to 1803, at least, the maxima occur with great regularity at intervals of ten years. Referring to Mr. Macleod's "Dictionary of Political Economy," pp. 627-8, we learn that commercial crises occurred in the years 1763, 1772-3, 1783, and 1793, in almost perfect coincidence with scarcity at Delhi. M. Clément Juglar, in his work, "Des Crises commerciales, et de leur Retour périodique," also assigns one to the year 1804. After this date the variation of prices becomes for a time much less marked and regular, and there also occurs a serious crisis about the year 1810, which appears to be exceptional; but in 1825 and 1836 the decennial periodicity again manifests itself, both in the prices of wheat at Delhi and in the state of English trade. The years of crisis are marked with the letter C.

When the above numbers are plotted out in the form of a curve, the earlier part of the series presents the appearance of a saw, with four or five high, sharp-pointed teeth at almost exactly equal distances of ten years. The first maximum, that of 1763, is perhaps imperfectly represented, and were the table extended backwards, the true maximum might fall in 1762. It is remarkable that after about the year 1807 the character of the curve suddenly and entirely changes, the oscillations becoming comparatively small, irregular, and rounded, although the periodicity, as already remarked, seems to recur in a less intense degree after 1823. This change in the curve may be due to some local causes, such as the opening of new roads and markets, and it is obviously important that we should learn whether this is the case, or whether some important meteorological variation is here manifested. This is not the only instance in which a well-marked decennial oscillation appears to be for a time suddenly arrested or thrown into confusion.

One difficulty which presents itself in connection with the above table is that the commercial crises in England occur *simultaneously* with the high prices in Delhi, or even in anticipation of the latter; now the effect cannot precede its cause, and in commercial matters we should expect an interval of a year or two to elapse before bad seasons in India make their effects felt here. The fact, however, is that the famines in Bengal appear to follow similar events in Madras. Thus it is well known that the great famine occurred in the year 1770, or even began in 1769, though it seems not to have made its mark at Delhi until 1773. This quite explains the fact that the English crisis was in 1772-3. Mr. F. C. Danvers, of the India Office (*Journal of Science*, N.S., vol. viii. p. 436), assigns famines in the Madras Presidency to the years 1781-3 and 1790-2. In fact Mr. Danvers explicitly points out this tendency of famines to travel northward, saying (p. 441): "It is a point worthy of remark that severe droughts in Northern India have, on several occasions, followed closely upon distress similarly caused in the Peninsula of India; thus the Madras famine of 1781 to 1783 was followed by one which affected Bengal, the north-western provinces, and the Punjab in 1783-4; the failure of rains which resulted in scarcity in many of the provinces of the Madras Presidency in 1824-5, was followed by a similar calamity in the North-western Provinces in the succeeding years. The "Guntoor" famine of 1833 preceded only by a few years one which affected the north-western and lower provinces of Bengal in 1837-8, and the Madras famine of 1866 was very closely followed by one in the North-western Provinces and the Punjab in 1868 to 1870." We see, then, that in looking for periodicity, we must confine each comparison to events of the same locality. It must also be allowed that the commencement of famine in India precedes by about two years the occurrence of commercial collapse in England.

It ought to be added that Everest refers to a journal published at Calcutta, called *Gleanings of Science*, which contains (vol. i. p. 368) a table of the prices of various kinds of grain at Chinsurah in Bengal, from 1700 to 1813. The volume is to be found in the British Museum; but on referring to it and plotting out the curve for the price of rice, it was very disappointing to find the series broken by gaps of several years every here and there, which renders it impossible to draw any safe inference, affirmative or negative. The table is said to have been drawn up by G. Herklots, the fiscal of Chinsurah, from authentic documents. Now, if such documents existed half a century ago, it is indispensable that minute inquiry should be made for any local records of the kind which may still exist.

Returning to the prices at Delhi, and taking the above table in connection with a mass of considerations of which I have given a mere outline at the last meeting of the British Association (see *Journal of the Statistical and*

Social Inquiry Society of Ireland, August, 1878, pp. 334-42; *NATURE*, vol. xix. pp. 33-37). I hold it to be established with a high degree of probability that the recurrence of manias and crises among the principal trading nations depends upon commerce with the east. This conclusion is confirmed by the fact that these fluctuations are but slightly felt by the non-trading nations, and that what these nations do feel is easily accounted for as an indirect effect.

It has been objected by the *Economist* that this explanation cannot be applied to the earlier crises in the years 1711, 1721, and 1732, because trade with India was then of insignificant dimensions. But the reading of many old books and tracts of the seventeenth and eighteenth centuries has convinced me that trade with India was always looked upon as of the highest importance. A large part of the political literature of the time was devoted to the subject, and under the Mercantile Theory the financial system of the country was framed mainly with an eye to Indian trade. The published returns of exports and imports probably give us little idea of the real amount of trade, as smuggling was very common in those days, and much of the Indian trade went on secretly in private ships or indirectly through Holland.

Dr. George Birdwood has lately been studying the records of the India Office, and he gives as the result of his extensive reading "that the history of modern Europe, and emphatically of England, has been the quest of the aromatic gum-resins, and balsams and condiments, and spices of India and the Indian Archipelago" (*Journal of the Society of Arts*, February 7, 1879, vol. xxvii. p. 192). This closely corresponds with the view which I have been gradually led to adopt of the cause of decennial crises.

While India is, no doubt, together with China, the principal source of disturbance, there is no reason to suppose that it is the only source. A nearly exhaustive analysis which I have made of the trade of England with various parts of the world during the last century, as given in Whitworth's valuable tables, fails to disclose any clear periodicity as regards European trade. The investigation of various long series of prices of agricultural produce in Europe also leads me to believe that the decennial periodicity, if felt in Europe at all, is over-borne by disturbing causes, or involved in too great complication to admit of discovery. On the other hand, I have fallen upon the very interesting and significant fact that the export trade from Maryland and Virginia exhibits what seems to me an unquestionable periodicity, with maxima in the years 1701, 1711-13, 1720, 1742, 1753, 1764, and 1774. The same tendency is not apparent in the trade of New England. Thus it is likely that crises may have an independent meteorological origin in the semi-tropical States of the Union; and, if so, it is probable that there are other tropical parts of the world where the meteorological conditions allow the cycle to manifest itself. This subject, so far as it has yet been studied, is full of important and mysterious facts, which stimulate the interest of the inquirer in a high degree. At the same time it is plain that sound conclusions can be reached only by most extensive analyses and comparisons of large series of facts. The search for the facts, too, among the records of the last two centuries, the suitable part of which has in too many cases probably perished, is so tedious and disappointing that it taxes the patience of the inquirer very severely. It is no jest at all.

But whatever be the area of the tropical and semi-tropical regions from which the decennial impulse comes, mainly India and China, no doubt, it does not follow that the extent of the commercial mania or crisis here is bounded by the variation of the foreign trade. The impulse from abroad is like the match which fires the inflammable spirits of the speculative classes. The history of many bubbles shows that there is no proportion be-

tween the stimulating cause and the height of folly to which the inflation of credit and prices may be carried. A mania is, in short, a kind of explosion of commercial folly followed by the natural collapse. The difficulty is to explain why this collapse so often comes at intervals of ten or eleven years, and I feel sure the explanation will be found in the cessation of demand from India and China occasioned by the failure of harvests there, ultimately due to changes of solar activity. Certainly the events of the last few years, as too well known to many sufferers, entirely coincide with this view, which is, nevertheless, made the subject of inconsiderate ridicule.

Hampstead, April 23

W. STANLEY JEVONS

JAMES NICOL, F.R.S.E., F.G.S.

ANOTHER of the links connecting us with the early days of geology has been severed by the death of the Professor of Natural History in the University of Aberdeen. For some years past Prof. Nicol's failing health prevented him from undertaking more work than his college duties required, so that he had somewhat fallen behind the crowd of younger aspirants to scientific reputation. It is a pleasant duty to recall his early services to geology. As far back as the year 1843 we find him contributing to the series of prize essays of the Highland Society a memoir on the geology of his native county, Peebleshire. Devoting himself with energy to the prosecution of his favourite pursuits, he prepared a useful little Guide to the Geology of Scotland, illustrated with maps and sections, and giving, from his own observations and the researches of previous writers, a compendious account of Scottish geognosy, so far as then known. Many years afterwards he published another compilation of Scottish geology in the form of a Geological Map of that country. He specially took up the mineralogical and petrographical department of geology, and showed his capacity for these subjects by publishing a text-book of mineralogy, which has kept its place as a work of reference. Appointed Assistant Secretary of the Geological Society, he in that capacity edited the Society's Journal, and had an opportunity of coming personally in contact with the foremost geologists of his time. Among those whose friendship he formed, one of the kindest and most serviceable was Murchison. Through the assistance of that active and powerful friend Nicol was appointed to the Chair of Geology at Cork, and a few years afterwards to the more lucrative post at Aberdeen, which he resigned only last year. During these years of official work he found time for a number of original papers chiefly on the geology of different parts of Scotland. Thus he returned once more to the study of the rocks of his own Tweed Valley to which he had been the first definitely to apply the term *Silurian*. In company with his friend and benefactor Murchison, he extended these observations into Ayrshire and the west of Scotland. With the same companion he visited the north-west of Scotland, and after a long journey through these regions produced an independent memoir, in which he suggested that much of the metamorphic rocks of the north-west Highlands consisted of altered Carboniferous formations. When the fossils found in the Assynt limestones proved to be unquestionably Lower Silurian he was of course compelled to retract his published suggestion. He then adopted a completely opposite view and endeavoured to prove that the rocks which he had thought might be altered Carboniferous were really the most ancient or fundamental masses of the west coast brought up everywhere to the surface again by a vast dislocation and inversion. In this view, no less than in that for which it was substituted, he was opposed by Murchison, who proved by many sections that the rocks in question really lay upon the fossiliferous limestones

and could not therefore be older than the Lower Silurian period. From the time of this dispute the late professor devoted himself chiefly to his duties at Mareschal College, where his capacity for business made him a most useful colleague. From summer to summer, however, he could resume the hammer and renew his acquaintance with old haunts or make himself familiar with new ones. In these excursions he was sometimes accompanied by an old geological friend to whom he could communicate the views he no longer cared to publish. With a kindly nature he united a certain timidity which made him shrink from publicity and led to his being less widely known than his personal qualities deserved that he should be.

NOTES

THE International Meteorological Congress was opened at Rome on Tuesday last week, nearly all the Countries of Europe being represented, as well as the United States. Prof. H. P. S. Smith and Mr. Scott represented this country. Prof. Cantoni was elected president, M. Wild, of St. Petersburg, vice-president, Dr. Hoffmeyer, of Copenhagen, and Mr. Scott, secretaries. The introductory address was given by M. Depretis, who spoke of the great influence exercised by the physical sciences on the progress of the other sciences, and consequently on the moral and economical development of nations. He referred to the important place of meteorology among the physical sciences, and concluded by welcoming the strangers to Italy. Dr. Buys Ballot was unable to be present, but Prof. Mascart read an address sent by him, full of scientific data and statistics, passing in review all the discoveries recently made in America and Europe in meteorological science. The report on the work of the permanent committee was read by the secretary of the committee, Mr. Scott. The congress then divided into sections for work.

THE annual meeting of the French Sociétés Savantes commenced on April 16 at the Sorbonne. The general sessions of the Section of Sciences were held under the presidency of M. Milne Edwards, on April 16, 17, and 18. MM. Faye and Wurtz were vice-presidents, and M. Blanchard the secretary. M. Faye delivered a lecture on the 18th in the large hall, on the Great Movements of the Atmosphere. General Nansouty, the Director of the Pic du Midi Observatory, gave an address, in which he complained of the interruptions in the telegraphic communications with Toulouse, caused by the snows during winter, and insisted upon the necessity of placing the wire under ground. M. Ferry, the Minister of Public Instruction, who is president, said that he should take the measures which were asked for by the gallant observer, whose devotion to science was so widely admired in France and abroad. M. Alluard, Director of Pry de Dôme Observatory, presented a series of maps tabulating the readings taken at Clermont Ferrand and on the top of the mountain. An intermediate station has been established. The final meeting of the Congress took place in the large hall of the Sorbonne, under the presidency of M. Ferry, who was assisted by a large number of officials. Five reports were read on the works of the Sociétés Savantes. The Minister, as usual, delivered a speech stating the projects of his administration. The number of learned societies in France is now 360. He stated that the Government spent 11,000,000 frs. in 1870 for the Faculties; the sum was now 30,000,000 frs. The list of rewards granted was then read over. The four gold medalists in science are M. Combercure, of Montpellier, for mathematical disquisitions, M. Dieulaufait, of Marseilles, for geology, M. Coquillon, for determining the quantity of inflammable gas contained in the air of coal-mines, and M. Schrader, for explorations in the Pyrenees.